1   FIELD

2

3   [0001]   The invention is related to closed-case removable

4   expansion cards for computer hosts, such cards having

5   particular application to portable computer hosts such as

6   handheld computing devices.

7

8   BACKGROUND

9

10   [0002]   The broad use of portable host computers, including

11   Personal Digital Assistants (PDAs), has been severely hampered

12   by limited capabilities for expansion or customization.

13   Expansion and application customization has been performed via

14   only one, or at most two, slots for removable expansion cards

15   for I/O, I/O adapters, memories, and memory adapters. Memory

16   expansion cards have included DRAM, SRAM, ROM, and Flash

17   technologies. I/O expansion cards have included dedicated

18   peripherals, networking, modems, wireless communications,

19   serial I/O, and bar-code and other scanners.

20

21   [0003]   Having only one slot meant choosing between memory

22   or peripheral expansion. In two-slot implementations, one of

23   the slots is generally used for peripheral expansion, and the

24   other for memory expansion. As market forces and consumer

25   demand are pushing future PDAs to be ever smaller, allocating

26   packaging volume for two-slots will be increasingly viewed as

27   a costly and nonviable solution.

28

1 <u>Memory and Expansion Card Standards</u>

2 **[0004]**   Two of the most popular industry standards for the

3 slots and removable cards are the PC Card and the CompactFlash

4 Card. The PC Card has a 16-bit variant, previously known as a

5 PCMCIA card, and a newer 32-bit variant, also known as a Card-

6 Bus card. U.S. Patent 5,815,426 ('426), ADAPTER FOR

7 INTERFACING AN INSERTABLE/REMOVABLE DIGITAL MEMORY APPARATUS

8 TO A HOST DATA PART, assigned to Nexcom Technology, and hereby

9 incorporated by reference, describes these and other removable

10 expansion card and memory types suitable for PDAs. In

11 addition to the PC Card and CompactFlash Card formats, the

12 '426 patent includes discussions of and references to

13 Miniature Cards, Sold State Floppy Disk Cards (SSFDCs),

14 MultiMediaCards (MMC), Integrated Circuit (IC) Cards (also

15 known as Smart Cards), and Subscriber Identification Module

16 (SIM) Cards.

17

18 <u>CompactFlash Card</u>

19 **[0005]**   Figures 1A, 1B, and 1C are different views of a

20 prior art Type II CompactFlash Card. The CompactFlash

21 physical, electrical, and software interface architecture is

22 taught in the CompactFlash Specification Revision 1.3,

23 Copyright 1998, by the CompactFlash Association, P.O. Box

24 51537, Palo Alto, CA 94303, which is hereby incorporated by

25 reference. Figures 1A, 1B, 1C, part of 6A, and part of 6B are

26 reproduced or derived from the CompactFlash Specification

27 document.

28

1   **[0006]**   U.S. Patent 5,887,145 ('145), REMOVABLE

2   MOTHER/DAUGHTER PERIPHERAL CARD, assigned to SanDisk

3   Corporation, and hereby incorporated by reference, describes

4   the required features of host systems for CompactFlash Cards,

5   including controllers required by CompactFlash memory cards

6   (CF cards) and comprehensive controllers required by

7   CompactFlash memory and I/O cards (CF+ cards).

8

9   <u>MultiMediaCard</u>

10   **[0007]**   Figure 2A and 2B represent a prior art

11   MultiMediaCard form factor and its pad definitions. Figure 3A

12   and 3B represent the prior art internal architecture of a

13   generic MultiMediaCard and its registers. Figure 4A

14   illustrates the prior art functional partitioning of a generic

15   MultiMediaCard system. Figure 5 illustrates the prior art

16   physical partitioning of a generic MultiMediaCard system.

17

18   **[0008]**   The MMC and MMC related system issues are taught in

19   the MultimediaCard System Summary Version 2.0, Copyright

20   January 1999, by the MultiMediaCard Association, 19672 Stevens

21   Creek Blvd., #404, Cupertino, CA 95014-2465, which is hereby

22   incorporated by reference. Figures 2A, 2B, 3A, 3B, 4, 5, and

23   part of 6A are reproduced or derived from the MultimediaCard

24   System Summary document.

25

26   **[0009]**   Figure 6A and 6B are different views comparing the

27   form factors of the prior art CompactFlash Card (top) and

28   MultiMediaCard (bottom). In each of 6A and 6B, the

1 CompactFlash Card and the MultiMediaCard are both roughly to

2 equal scale.

3

4 Adapters for Removable Memories

5 [0010]   Adapters exist or have been prophetically disclosed

6 for physically and electrically coupling a removable memory on

7 a slide, or stick, to a portable host via a removable

8 expansion card of either the PCMCIA Card or CompactFlash Card

9 form factors. The previously mentioned '426 patent describes

10 such removable memory adapters. The focus of these existing

11 memory adapters has been limited to merely providing an

12 interface adapter, or bridge, between a first interface type

13 (the host to removable-expansion-card interface) and a second

14 interface type (the removable memory stick).

15

16 PC Card Mother and CompactFlash Card Daughter Combinations

17 [0011]   Adapters exist or have been prophetically disclosed

18 that comprise a special mother PC Card designed to accept one

19 or more daughter CompactFlash Cards of one or more types. The

20 previously '145 patent describes such CompactFlash adapters.

21 The focus of these existing mother/daughter combinations has

22 also been limited. First, the daughters have been used for

23 memory expansion for the host platform, primarily in the form

24 of flash-memory-based mass-storage-like devices. In this

25 first approach, the mother card provides the requisite mass-

26 storage controller functionality. Second, the daughters have

27 been used for dedicated peripheral, I/O, or communication

28 functions. In this second approach, the mother card has a so-

29 called comprehensive controller that augments the mass-storage

1   controller functionality with functions commonly required or

2   useful to multiple daughter cards. Third, in a variation of

3   either of the first two paradigms, functions of the general-

4   purpose host may be relocated to the mother card.

5

6   Background for PC-Card Based I/O Functions

7   **[0012]**   Techniques are known in the art for making and using

8   systems that perform such I/O functions in a PC card. For

9   example, see U.S. Patent 5,671,374 ('374), PCMCIA INTERFACE

10   CARD COUPLING INPUT DEVICES SUCH AS BARCODE SCANNING ENGINES

11   TO PERSONAL DIGITAL ASSISTANTS AND PALMTOP COMPUTERS, assigned

12   to TPS Electronics, which is hereby incorporated by reference.

13   The '374 patent teaches the use of PDAs and similar hosts

14   equipped with PC card interfaces for I/O devices including

15   portable laser-scanners, magnetic stripe and ink readers,

16   keyboards and keypads, OCR devices, and trackballs.

17

18   **[0013]**   Techniques are also known in the art for making and

19   using PC Card-based radios for applications based in a

20   portable host. For example, see U.S. Patent 5,519,577 ('577),

21   SPREAD SPECTRUM RADIO INCORPORATED IN A PCMCIA TYPE II CARD

22   HOLDER, assigned to Symbol Technologies, and hereby

23   incorporated by reference.

24

25   **[0014]**   Techniques are also known in the art for making and

26   using disk emulation devices based on flash memory. For

27   example, see U.S. Patent 5,291,584 ('584), METHODS AND

28   APPARATUS FOR HARD DISK EMULATION, assigned to Nexcom

29   Technology, and hereby incorporated by reference.

1 Background for Relevant Application Specific Functions

2 **[0015]** Techniques are known in the art for making and using

3 systems that download or capture compressed digital audio for

4 storage and later playback using dedicated removable media.

5 For example, U.S. Patent 5,676,734 ('734), SYSTEM FOR

6 TRANSMITTING DESIRED DIGITAL VIDEO OR AUDIO SIGNALS, assigned

7 to Parsec Sight/Sound, and hereby incorporated by reference,

8 teaches a system for transmitting digital video or audio

9 signals over a telecommunications link from a first to a

10 second party. In addition, U.S. Patent 5,579,430 ('430),

11 DIGITAL ENCODING PROCESS, assigned to Fraunhofer Gesellschaft

12 zur Foerderung der angewandten Forschung e.V., and hereby

13 incorporated by reference, teaches processes for encoding

14 digitized analog signals. Such processes are useful for

15 insuring high-quality reproduction while reducing transmission

16 bandwidth and data storage requirements.

17

18 **[0016]** Techniques are also known in the art for making and

19 using record and playback portable host devices based on a

20 dedicated flash memory. For example, see U.S. Patent

21 5,491,774 ('774), HANDHELD RECORD AND PLAYBACK DEVICE WITH

22 FLASH MEMORY, assigned to Comp General Corporation, and hereby

23 incorporated by reference, and U.S. Patent 5,839,108 ('108),

24 FLASH MEMORY FILE SYSTEM IN A HANDHELD RECORD AND PLAYBACK

25 DEVICE, assigned to Norris Communications, also hereby

26 incorporated by reference.

27

1   <u>Limitations of Previous Approaches</u>

2   **[0017]**   In general purpose portable hosts, populating an

3   expansion slot has meant choosing one of either removable

4   memory or peripheral expansion for that slot. When used for

5   memory expansion, the removable memory has been limited to use

6   for the system or application software running on the host.

7   In essence, the removable memory has only been used as host-

8   dedicated memory. This was done either directly, e.g., as

9   some portion of the main-memory of the host, or indirectly as

10   an emulation substitute for host mass-storage (i.e., disk

11   drives).

12

13   **[0018]**   When used for I/O expansion, the expansion I/O-cards

14   have not had access to a private removable media/memory. This

15   has prevented portable computer hosts, such as PDAs, from

16   being used as a customizable platform for many application-

17   specific functions that require a removable memory dedicated

18   to the application.

19

20

21   SUMMARY

22

23   **[0019]**   The utility of portable computer hosts, such as

24   PDAs, is enhanced by methods and apparatus for closed-case

25   removable expansion cards having a removable memory in both a

26   first and second embodiment. In both the first and second

27   embodiments the closed-case removable expansion cards

28   preferably use a Type II CompactFlash form factor. In the

29   first embodiment the removable memory is in combination with

1   an external-I/O connector or permanently attached external-I/O

2   device, providing both I/O and memory functions in a single

3   closed-case removable expansion card. This increases the

4   expansion functional density for portable computer hosts, such

5   as PDAs. That is, it increases the amount of functionality

6   that can be accommodated within a given volume allocation for

7   expansion devices. It also provides a viable alternative to

8   2-slot implementations.

9

10   **[0020]**   In the second embodiment the removable memory is a

11   private memory for application specific circuitry within the

12   closed-case-removable expansion card. This enhances the

13   utility of portable computer hosts, such as PDAs, as universal

14   chassises for application specific uses. The standard

15   CompactFlash physical and electrical interface couples the

16   application specific card to the host, which provides user

17   interface functions for the application. The cards include a

18   top located slot and an internal connector for accepting a

19   MultiMediaCard as the private removable memory. In addition,

20   the application specific card will generally have some manner

21   of I/O to required external devices, such as scanning devices,

22   sensors, or transducers. Otherwise, all functionality for the

23   application specific function is self-contained within the

24   application specific card.

25

26   **[0021]**   Particular application specific cards for

27   customizing general purpose PDAs via the instant invention

28   include a media-player card for digitized media stored on

1   removable memory and a bar-code-scanner card having scanning

2   data stored on removable memory.

3

4

5   BRIEF DESCRIPTION OF DRAWINGS

6

7   [0022]   Figures 1A, 1B, and 1C are different views of a

8   prior art Type II CompactFlash card.

9

10 [0023]   Figure 2A and 2B represent a prior art

11 MultiMediaCard form factor and its pad definitions.

12

13 [0024]   Figure 3A and 3B represent the prior art internal

14 architecture of a generic MultiMediaCard and its registers.

15

16 [0025]   Figure 4A illustrates the prior art functional

17 partitioning of a generic MultiMediaCard system.

18

19 [0026]   Figure 5 illustrates the prior art physical

20 partitioning of a generic MultiMediaCard system.

21

22 [0027]   Figure 6A and 6B compares the form factors of the

23 prior art CompactFlash card (top) and MultiMediaCard (bottom).

24

25 [0028]   Figure 7 illustrates a PDA equipped with a removable

26 expansion card having both I/O and removable memory in

27 accordance with the present invention.

28

1   [0029]   Figure 8 illustrates some of the various types of

2   I/O for which the PDA and removable expansion card of Figure 7

3   may be equipped.

4

5   [0030]   Figure 9 is an abstract drawing representing the

6   removable expansion card of Figure 7 separate from the PDA,

7   and with the I/O and memory disengaged from the removable

8   expansion card.

9

10   [0031]   Figure 10 is an abstract drawing representing the

11   construction detail of the upper and lower frame of the

12   removable expansion card of Figure 7.

13

14   [0032]   Figure 11 is an abstract drawing representing an

15   exploded view of the removable expansion card of Figure 7,

16   including the outer frame, inner PCB, and connectors.

17

18   [0033]   Figure 12A is an abstract drawing representing a

19   view of the removable expansion card of Figure 7, with the

20   outer frame removed, and a removable memory roughly aligned

21   with the contact fingers to which it mates within the

22   removable expansion card.

23

24   [0034]   Figure 12B is an abstract drawing representing a cut

25   away side view of the removable expansion card of Figure 7,

26   with the removable memory inserted into the removable

27   expansion card.

28

1 [0035] Figure 13A is an abstract drawing representing an

2 end view silhouette of the removable expansion card of Figure

3 7.

4

5 [0036] Figure 13B is an abstract drawing representing a

6 cross-sectional view silhouette of the upper frame member of

7 the removable expansion card of Figure 7.

8

9

10 DETAILED DESCRIPTION

11

12 Components of the Expansion Card

13 [0037] Figure 9 is an abstract drawing representing a

14 closed-case removable expansion card **100**, i.e., an expansion

15 card that may be inserted into and removed out of a closed-

16 case computer host. The card is especially suitable for use

17 in a portable host, such as a PDA. In accordance with the

18 present invention, the expansion card of Figure 9 includes a

19 connector **141** for I/O interconnect and a slot **121** for a

20 removable memory. Figure 9 shows the I/O interconnect **140** and

21 removable memory **120** disengaged from the removable expansion

22 card.

23

24 [0038] Figure 10 is an abstract drawing representing the

25 construction detail of the upper **105** and lower **110** frame

26 members of the removable expansion card **100** of Figure 9. An

27 opening **111** is provided in the lower frame **110** for receiving

28 the connector **141** for I/O interconnect.

29

1   **[0039]**   Figure 11 is an abstract drawing representing an

2   exploded view of the removable expansion card **100** of Figure 9,

3   including the outer frame, inner PCB **115**, and connectors.

4   Visible for the first time in the view of Figure 11, a second

5   opening **113** is provided in the lower frame **110** for receiving

6   the connector **150** for host interconnect. Additionally, a slot

7   **112** is provided on both sides of the opening **111** to aid in the

8   alignment and retention of the connector **141**, and a slot **114**

9   is provided on both sides of opening **113** to aid in the

10   alignment and retention of the connector **150**. An opening **116**

11   is provided in the PCB for receiving the connector **141**.

12

13   **[0040]**   Figure 12A is an abstract drawing representing a

14   view of the removable expansion card **100** of Figure 9, with the

15   outer frame members removed, and a removable memory **120**

16   roughly aligned with the contact fingers **180** to which it mates

17   within the removable expansion card. Circuitry 160 is

18   provided, including I/O adapter circuitry, removable memory

19   adapter circuitry, and application-specific circuitry. A

20   support shelf **170** supports, aligns, separates, and isolates

21   the underside of the contact fingers **180** from the circuitry

22   **160**.

23

24   **[0041]**   Figure 12B is an abstract drawing representing a cut

25   away side view of the removable expansion card **100** of Figure

26   9, with the removable memory **120** inserted into the removable

27   expansion card.

28

1　　**[0042]**　　Figure 13A is an abstract drawing representing an

2　　end view silhouette of the removable expansion card **100** of

3　　Figure 9.　Figure 13B is an abstract drawing representing a

4　　cross-sectional view silhouette of the upper frame member 105

5　　of the removable expansion card 100 of Figure 9.　Guides **190**

6　　provide alignment and support for removable memory inserted

7　　via slot **121**.

8

9　　**[0043]**　　In a preferred embodiment, the expansion card **100**

10　　and associated host connector **150** are compatible with the Type

11　　II CompactFlash Card as described in the previously referenced

12　　CompactFlash Specification.　The I/O connector **141** is

13　　compatible with a PC-Card industry standard Honda-style 15-pin

14　　connector.　The slot **121**, removable memory **120**, and removable

15　　memory adapter circuitry of circuitry **160**, are compatible with

16　　the MultiMediaCard as described in the previously referenced

17　　MultiMediaCard System Summary.

18

19　　<u>Circuitry on the Expansion Card</u>

20　　**[0044]**　　In a first embodiment of the invention, circuitry

21　　**160** includes I/O adapter circuitry and removable memory

22　　adapter circuitry.　The I/O adapter functionality may include

23　　one or more of, but is not limited to, Ethernet, serial port,

24　　audio, telephone, antenna, and special-function interfaces

25　　such as bar code and other scanners.　The removable memory

26　　adapter functionality may include one or more of, but is not

27　　limited to, main memory expansion, mass-media emulation, and

28　　other host-based special-purpose memory applications.

29

1   **[0045]**   In accordance with a second embodiment, circuitry

2   **160** further includes application-specific circuitry for which

3   the management of the removable memory is an ancillary

4   function to the primary function of the specific application.

5   Specific examples of such application-specific expansion cards

6   having both I/O and removable memory are provided in later

7   sections.

8

9   **[0046]**   In preferred implementations of both of the first

10 and second embodiments mentioned above, the functions

11 performed by the removable memory are those of a

12 MultiMediaCard adapter as illustrated in the MultiMediaCard

13 adapter section of the MultiMediaCard system architecture

14 diagram of Figure 4. If the removable memory is being used to

15 provide host-base memory expansion, such as described for the

16 first embodiment, then the host must provide the functionality

17 illustrated by the Application and Application Adapter

18 sections of Figure 4. If the removable memory is being used

19 at least sometimes as an ancillary memory (at least sometimes

20 private) to the application-specific circuitry contained on

21 the expansion card, such as for the second embodiment, then

22 the application-specific circuitry must provide the

23 Application and Application Adapter section functionality, or

24 else the application-specific circuitry must call on host

25 services for such functionality.

26

27 **[0047]**   Examples of known techniques for making and using

28 other types of memory adapter circuitry for closed-case

29 expansion cards or with flash memory are found in the

1   previously referenced '145, '426, '584, '774, and '108

2   patents, among others. Examples of known techniques for

3   making and using I/O adapter and application-specific

4   circuitry for functions implemented in closed-case expansion

5   cards and with flash memory are found in the previously

6   referenced '374, '577, '774, and '108 patents, among others.

7

8   <u>Frame Kit Assembly</u>

9   **[0048]**   The top and bottom frames may be composed of metal

10   or plastic. In a preferred embodiment, the top and bottom

11   frame portions each have a plastic base augmented with an

12   outer metal plate over much of the interior region of the

13   large panel surface of each portion. The metal plate extends

14   to the edges of the panel at the connector ends of each

15   portion and is attached to both connectors. In addition,

16   smaller metal strips, or ears, on both sides at the finger-

17   grip end (opposite to the host connector) extend from the

18   plate to the edges of the panel and continue onto the sides.

19   The frame kit is assembled and the side strips are sonically

20   welded together on both sides of the casings. The welded

21   strips and plates form a single continuous metal band around

22   the top and bottom frames that permanently physically retains

23   the assembled kit.

24

25   <u>I/O Interconnect Options</u>

26   **[0049]**   I/O devices may be interconnected with the expansion

27   card via three different embodiments. First, a PC-Card

28   industry-standard Honda-style 15-pin connector may be used

29   with a mating detachable cable. Detachable cables are

1   preferred for light-duty applications where a continuous I/O

2   device connection is neither needed nor desired. Second, a

3   fully integrated fixed cable, having a molded strain relief

4   may be used. Such a fixed cable maintains solid contact in

5   high vibration environments, is protected against lateral

6   stress, and seals out dust. Fixed cables are preferred for

7   dedicated industrial or field applications. Third, at least a

8   portion of the I/O device may be abutted and attached (often

9   via a snap-in-place mechanism) directly to the expansion card,

10 obviating the need for either a detachable or fixed cable.

11 Cableless snap-on I/O devices are preferred for small mostly

12 self-contained I/O devices that permit a compact PDA,

13 expansion-card, I/O-device combination that handles physically

14 as a single piece of equipment. In the instant invention,

15 such snap-on I/O devices must make allowance for the removable

16 memory.

17

18 <u>PDA having Application Specific Card with Removable Media</u>

19 **[0050]** Figure 7 illustrates a PDA **200** equipped with a

20 removable expansion card **100** having both I/O interconnect **140**

21 and removable memory **120** in accordance with the present

22 invention. The application specific circuitry of the

23 expansion card may be used in conjunction with application

24 specific software running on the PDA. This permits the

25 application specific circuitry of the expansion card to make

26 use of the output (e.g., display, sound) and input (e.g.,

27 tablet, buttons, any I/O ports) capabilities of the PDA for

28 user interface functions associated with the specific

29 application. In particular the PDA's display/input-tablet

1 provides for virtual controls and visual indicators for the

2 application. Figure 8 illustrates some of the various types

3 of I/O for which the PDA and removable expansion card of

4 Figure 7 may be equipped. Application-specific functions may

5 include special-function mixed-signal electronics, special-

6 function I/O, special-function data-pumps, and special-

7 function accelerators.

8

9 <u>Application Specific Embodiments</u>

10

11 <u>Generic Removable Media Applications</u>

12 **[0051]** The present invention enables general-purpose

13 portable hosts to perform application-specific functions

14 requiring dedicated ROM. A first large ROM-based application

15 category is that of prerecorded media, such as music, audio,

16 video, and text (for books, newspapers, and other

17 publications). A second large ROM-based application category

18 is customization for programmable devices, such as games,

19 language translators, and other devices having "personality"

20 modules.

21

22 **[0052]** The present invention also enables general-purpose

23 portable hosts to perform application-specific functions

24 requiring non-volatile read/write memory for data-capture,

25 data-logging, data-checkpoints or backups, transaction

26 logging, and data-transport.

27

28 **[0053]** In the illustrated embodiments the non-volatile

29 read/write memory is flash memory in accordance with the

1 standard MultiMediaCard. Such removable flash-memory-based

2 application-specific functions have particular utility to

3 medical and other data acquisition, secure commerce, financial

4 and personal productivity devices making use of unique

5 removable memories for each of multiple individuals, projects,

6 or accounts.

7

8 **[0054]** The removable flash-based memory is also well suited

9 where "sneaker-net" is a viable data transport. Provided

10 manual/user intervention is acceptable, and depending on the

11 speed of data link I/O incorporated into the expansion card,

12 the physical transport of a removable memory device between a

13 PDA-based expansion card and an external system may provide

14 the best solution to fast local transport of large data-sets.

15 For similar reasons, the use of removable memory devices may

16 provide the best solution to rapidly reconfiguring an

17 application-specific expansion card to initiate a large

18 program or use a large data sets. The use of labeled, color-

19 coded, or otherwise distinctive, removable memory devices also

20 may provide the best solution for ease of use for users

21 needing to select a particular program or data set from many

22 for reconfiguring an application specific expansion card.

1 <u>Specific Application Examples</u>

2

3 <u>Media Player Application</u>

4 **[0055]** The present invention permits a general purpose PDA

5 to be customized (specially adapted) for use as a

6 portable/wearable media player, at the highest-level of ·

7 functionality not unlike a portable Compact Disk player. Such

8 a player uses the removable memory to store and playback

9 digitally encoded media such as music, audio, or video. In a

10 preferred embodiment the player makes use of the MPEG Layer 3

11 standard for digital audio encoding, generally known as MP3.

12 Another embodiment makes use of the Microsoft Digital Audio

13 standard. Other aspects of a preferred embodiment include an

14 integral AM/FM receiver, a connector for a headset with an

15 integral antenna for the receiver, and an auto-start on insert

16 feature that initiates the media playback upon insertion of

17 the removable memory. The PDA's display/input-tablet provides

18 the virtual controls and visual indicators for the media

19 player.

20

21 <u>Module For Subscriber Services</u>

22 **[0056]** In accordance with the present invention, an

23 expansion card having I/O and removable memory is inserted

24 into a computer host. The I/O is coupled to a receiver

25 capable of receiving a large number of broadcast messages and

26 services. The removable memory contains subscriber services

27 information for each individual user. The expansion card uses

28 the subscriber services information to filter out messages and

29 services not applicable to the present status of the

1   subscriber. The PDA's display/input-tablet provides the

2   virtual controls and visual indicators for the display and

3   access of captured messages and services.

4

5   <u>Bar-Code Scanning Application (a backup storage example)</u>

6   **[0057]**   In accordance with the present invention, an

7   expansion card having I/O and removable memory is inserted

8   into a computer host, a bar-coding peripheral is connected to

9   the I/O portion of the card, and a removable memory card is

10   inserted into the memory slot of the card. After each scan

11   the scanned information is transferred through the I/O

12   connection to the host computer for processing. Additionally,

13   a backup copy of the scanned information is stored on the

14   removable memory. Should the computer host fail or should the

15   operator need to verify scans, the backup can be interrogated

16   with the same or a different host.

17

18   <u>Personal Environmental and Medical Monitoring Devices</u>

19   **[0058]**   The present invention permits a general purpose PDA

20   to be customized as a portable/wearable personal environmental

21   monitor. Equipped with the appropriate sensors and

22   application-specific circuitry for sensor signal processing,

23   such a device performs time-stamped data logging of

24   environmental attributes such as ionizing radiation,

25   temperature, and humidity. Similarly, a portable/wearable

26   personal medial monitor data logs health-related attributes

27   such as pulse, temperature, respiration, and blood pressure.

28   The PDA's display/input-tablet provides the virtual controls

29   and visual indicators for the monitoring devices.

1 <u>Automotive and Industrial Diagnostic Monitoring and Control</u>

2 **[0059]** The combined I/O interconnect and removable memory

3 of the present invention also permits a general purpose PDA to

4 be customized (specially adapted) for use as a data logging

5 diagnostic monitor or time-based control device. It is known

6 that the diagnostic connectors of certain vehicles can be

7 adapted to interface with PDAs for real-time monitoring of

8 critical vehicle subsystems. The present invention permits

9 such diagnostic monitoring data to be communicated via the I/O

10 interconnect and logged to the removable memory. Such a tool

11 facilitates tracking subsystem performance over extended

12 periods of time, and permits real-time and deferred graphics

13 of time-varying system performance attributes. The PDA's

14 display/input-tablet provides the virtual controls and visual

15 indicators for the diagnostic monitor.

16

17 <u>Conclusion</u>

18 **[0060]** Although the present invention has been described

19 using particular illustrative embodiments, it will be

20 understood that many variations in construction, arrangement

21 and use are possible within the scope of the invention. For

22 example the number of I/O interconnects, removable memories,

23 contact fingers, number and type of application-specific

24 circuits, and the size, speed, and type of technology used may

25 generally be varied in each component of the invention. The

26 invention is not limited to the standard CompactFlash form

27 factor, but other closed-case removable expansion card form

28 factors are equally applicable. Nor is the invention limited

29 to use of the standard MultiMediaCard, as other types of

1   removable memory or media may also be employed. Functionally

2   equivalent techniques known to those skilled in the art may be

3   employed instead of those illustrated to implement various

4   components. The present invention is thus to be construed as

5   including all possible modification and variations encompassed

6   within the scope of the appended claims.